Micro-atmospheric Microwell Plate Technology Project (Microatm)

Completed Technology Project (2011 - 2012)

Project Introduction

Valuable research in gravitational biology, synthetic biology, proteomics, and biotechnology can be enhanced by using microwell platforms. The microwell platform provides a simple technique for doing massively parallel studies. However, to be effectively used in microgravity significant improvements in our ability to manage gases in these systems is needed. We are developing a system that addresses these limitations. This research enables a wide range foundational research in Space Synthetic Biology, Fundamental Space Biology, and Astrobiology, ultimately generating the knowledge required to engineer a potentially broad range of space biotechnology applications employing synthetic organisms and microbial bioreactors for in situ resource utilization and biological life support systems.

Microwell-plates have become standardized formats for biological research. However, valuable biological microgravity research cannot be accomplished using these technologies without improvements in our ability to deliver, remove, and measure gases.

In microgravity, where buoyancy driven mixing is minimal, the buildup of CO_2 in solutions containing aerobic bacteria can adversely impact growth rates and mask more subtle effects. Likewise, the delivery of O_2 and removal of metabolic by-products at the bottom of a microwell in microgravity is difficult to achieve and even more difficult to measure. Gas that builds up and is not removed will supersaturate the growth medium and form bubbles causing interference with detection and analysis.

What is needed is a standard microwell-plate that is sealed with a transparent cover slip and has the capability to control, mix, and measure gas concentrations inside the microwells. To accomplish this requires the integration of a range of state-of-the-art micro and nano technologies such as micro-sensors that measure gas concentrations of O_2, N_2, CO_2, H2S, NO and some organics. Also needed are technologies that add O_2 and N_2 to micro-atmospheres; remove CO_2, NO, H_2S, and organics; as well as micro-technologies that can control gas mixing, and gas circulation in micro-atmospheres.

This CIF grant developed an initial feasibility study of a sealed micro well that can measure and control the micro atmosphere contained in individual micro wells. This system uses carbon nanotube sensors to measure gas concentrations at a nano scale within the microwell. Gas phase adsorbents are used as gas reservoirs to add and remove atmospheric/metabolic gases from the well. Micro pumps and valves are used to circulate gases and insure good mixing in the well.

Anticipated Benefits

Valuable research in gravitational biology, synthetic biology, proteomics, and

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

Center Innovation Fund: ARC CIF

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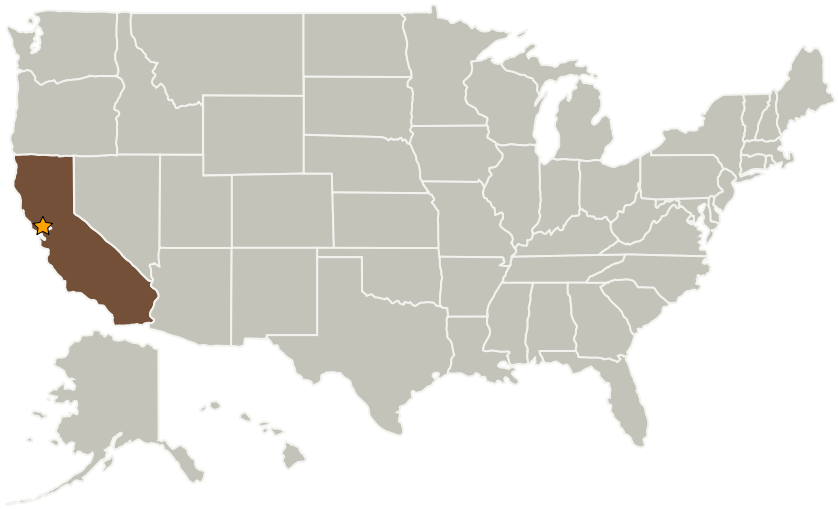
NASA specific

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California

Project Management

Program Director:
Michael R Lapointe

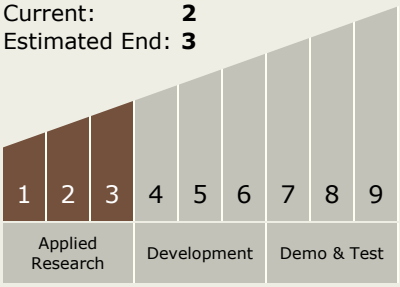
Program Manager:
Harry Partridge

Principal Investigator:
Michael Flynn

Co-Investigator:
Rocco L Mancinelli

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.5 ECLSS Modeling and Simulation Tools

Center Innovation Fund: ARC CIF

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Primary U.S. Work Locations
California

Stories

1676 Review (17536)
(https://techport.nasa.gov/file/8736)